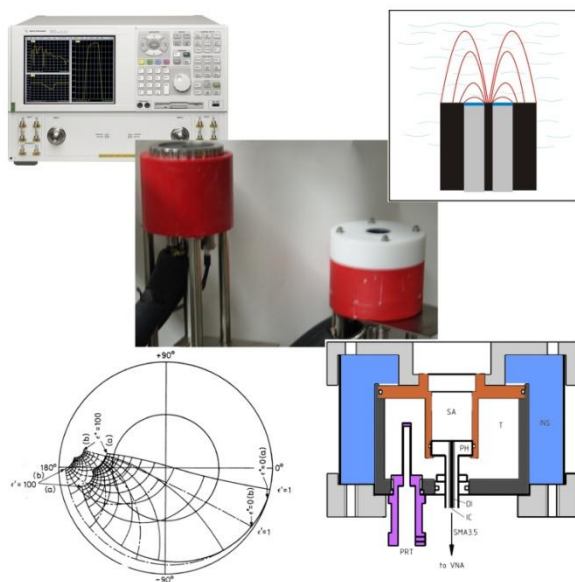


Facilities

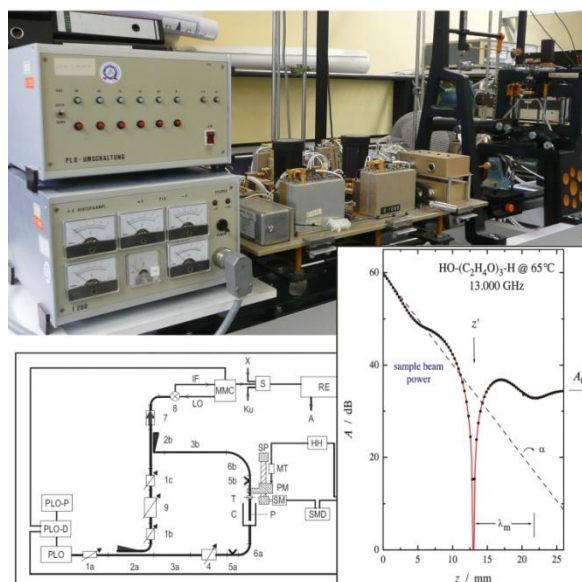
Dielectric Relaxation Spectroscopy

Our instrumentation currently covers the frequency range of 10 MHz to 89 GHz (up to ~ 10 THz in collaboration with other groups) in the temperature range of -25 to 75 °C (± 0.05 °C). The uncertainty in relative permittivity, $\epsilon'(\nu)$, and total loss, $\eta''(\nu)$, is $\sim 2\%$ of the static permittivity, ϵ , of the sample. The equipment is optimized for samples of high polarity and/or high electric conductivity. It was successfully used to investigate liquid samples with static permittivities in the range $3 \leq \epsilon \leq 300$, conductivities up to 20 S/m and viscosities up to 1 Pa·s.

For $0.01 \leq \nu / \text{GHz} \leq 50$ we generally perform reflection experiments with an Agilent E8364B vector network analyzer (VNA) and corresponding E-Cal module. Various coaxial-line cut-off cells are used for $\nu < 0.5$ GHz, whereas two open-ended coaxial-line probes cover $0.2 \leq \nu / \text{GHz} \leq 20$ and $1 \leq \nu / \text{GHz} \leq 50$, respectively. If necessary, three variable-pathlength waveguide cells covering 8.5 – 40 GHz can be hooked to the VNA for transmission measurements. The 60 – 89 GHz range is covered by a waveguide interferometer with variable-pathlength transmission cell.



Open-ended coaxial line reflection setup with VNA.



Waveguide interferometer.

Viscosity

Dynamical viscosities, η , can be measured at 5 to 135 °C with a temperature uncertainty ≤ 0.05 K using an automated rolling-ball viscometer (Anton Paar AMVn).

Density

For density measurements an Anton Paar DMA 5000 M vibrating tube densimeter, covering 0 – 90 °C is available.

Conductivity



Electrical conductivities, κ , is measured with a computer controlled setup consisting of a Huber Unistat 705 as the thermostat (-45 to 80 °C, temperature stability <0.005 K), a high-precision LCR bridge (HAMEG HM8118) for resistance measurement (relative uncertainty ≤ 0.0005), and a switchboard to address up to 6 three two-electrode capillary cells mounted on the thermostat lid. For high temperatures (40 to 195 °C), a manually set high-temperature thermostat (homebuilt, temperature stability <0.005 K) is available.

Sample Handling

High-vacuum drying facilities are available. Samples can be prepared a N₂-flushed glove box and all measurements steps performed under exclusion of moisture.